



## Assessment on the status of *Osyris quadripartita* Decn. in Borena, East Shewa, West and East Guji Zones, Oromia region, Ethiopia

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### ABSTRACT

*Osyris quadrrpartita*, is an economically important plant species that occurs in most Ethiopian regions, but its population status, threat, habitat preference and its associated plant species have not been studied in Oromia region, Ethiopia. Therefore, the objective of this study was to assess the population status, threat and habitat preference of *O.s quadripartita* and associated species in Borena, East Shewa, East and West Guji Zones of the Oromia region, Ethiopia. Accordingly, the study was conducted in selected nineteen districts within these zones. From the nineteen districts, thirty three forest areas were selected purposively based on the distribution

of *O. quadripartita*. The data was collected through Participatory Rural Appraisal (PRA) whereby vegetation survey, direct observation and local informants' interviews were conducted. The results showed that over in half of the exploration sites (51.4%), *O. quadripartita* was not found. Only in few areas of the exploration sites (8.1%), *O.s quadripartita* was relatively abundant whereas in 24.3% and 16.2% of the exploration sites *O. quadripartita* was found rarely and very rarely respectively. Moreover, most of the areas that *O. quadripartita* was found abundantly were protected areas (community forests, closure areas and state forests). Furthermore, the plant's poor natural regenerative ability from seed and root sucker and dioecious and root hemi parasitic nature may threaten the survival of the plant. As a result of these facts the cultivation of the plant should be encouraged.

**Keywords:** *Osyris quadripartita*, population status, threat, rare and socio economic importance.

## 1. INTRODUCTION

*Osyris quadripartita* Decn., East African Sandalwood (Santalaceae) is an evergreen, root hemi parasitic, dioecious shrub or tree up to 7 m tall and highly branched. It is most commonly found in Gallery forest *Juniperus*, *Podocarpus*, *Combretum* and *Dodonea* woodland, *Erica* scrub, *Acacia nilotica*, *Commiphora* scrub, on rocky slopes or along the margins of dry forest, degraded woodland and scrub; 900 to -2900 m.a.s.l in areas with mean annual rainfall of 600 to 1600 mm. Occurs in most Ethiopian regions, throughout Africa, Southern Asia to China [1,3, 4].

*Osyris quadripartita* is indigenous to east Africa, used for its scented wood and to extract essential oil. The tree is harvested from the wild for local use as a food, medicine and source of wood and materials. The wood is sold locally and also traded internationally for its essential oil which is used in making perfume. The wood is over-exploited in parts of its range despite legal protection. Its numbers have been greatly reduced by overexploitation of its roots, which are the source of an expensive essential oil [2, 3, 4].

*Osyris quadripartita* has recently entered the international market as a substitute of the traditional sandalwood oil originally sourced from Asia and Australia. The oil is useful in perfumery, pharmaceutical and religious practices. The limited supply, coupled with high demand and escalating prices of sandalwood oil from the traditional source countries have led to exploitation of the East African sandalwood as a preferred alternative. This is occasioned by diminishing populations and strict regulations on Australian sandalwood. In India and China, Sandalwood is under State protection and often referred to as sacred tree and harvesting from the wild is prohibited. This has shifted the trade to the East African sandalwood leading to over exploitation of the species in the range States. The exploitation of *O. quadripartita* from Africa could soon drive the species to extinction unless proper control measures are put in place to regulate international trade in the species [5,4].

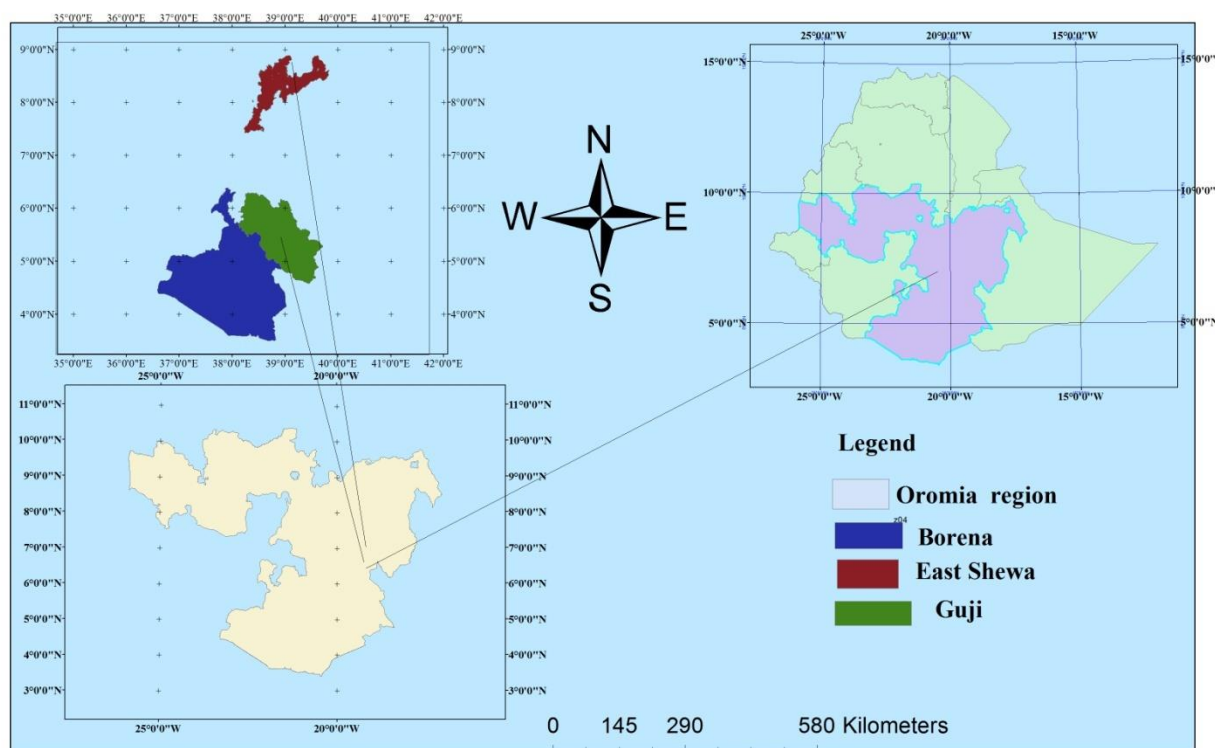
As a safeguard, populations of the species occurring in eastern Africa have been protected under Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) Appendix II. This means that, international trade in Sandalwood from these countries is subject to strict regulation in order to avoid utilization incompatible with the survival of the species in the wild. Protection of natural populations will be achieved by setting up a domestication programme where cultivation and harvesting of the species will ease pressure on natural populations while providing income to growers [4,5].

In Ethiopia the population status of *O. quadripartita* is not well studied and unknown. Therefore, the objectives of this exploration were to assess the population status, availability, threat and habitat preference of *O. quadripartita* and associated species in Borena, East Shewa, west and East Guji Zones of Oromia region, Ethiopia.

## 2. MATERIALS AND METHODS

### Methods of data collections

The study was conducted in four zones namely: Borena, East Shewa, west and East Guji (figure 1). From the four zones the study was conducted only on nineteen districts. Accordingly, Abaya, Gelana, Melka soda, Teltele, Dillo, Miyo, Moyale, Dahas, Goro-dala, Wadera, Adola, Shakiso, Liben Chqala, Dugida, Bora, Lume, Fentale, Boset and Adama were selected to conduct this assessment study. From nineteen districts, thirty three forest areas (community forests, closure areas and state forests) were selected purposively based on the distribution of *O. quadripartita*.



**Figure 1** Administrative Map of the study areas

These three ways of data collection were used:

#### Local informants interview

Local informants included were:- districts agricultural bureau officials and experts and male and female farmers or pastoralists.

#### Direct observation

The researchers were also observed every forest patch if they were suspected the existence of *O. quadripartita* and check for presence/absence. If the species was present, the researchers were estimated its abundance.

#### Vegetation survey

The closure areas or forest patches identified by the help of informants or found during our random observation and where there seemed to be abundant *O. quadripartita* individuals, the researchers laid twenty nine 20x20 plots and within each plot, the number of *Osyris quadripartita* present was counted so that abundance per hectare was estimated. The sampling method was based on line transect approach and systematic random sampling techniques using one transect line. The assessment was conducted in community forest, communal land and area closures. Two consecutive plots were separated from each other by 100 m. In each plot, the number of *O. quadripartita* was recorded and the associated species also identified and recorded or assessed the abundance and availability of *O. quadripartita*.

#### Methods of Data Analysis

The collected data was analyzed by using SPSS (statistical package for social sciences). A descriptive statistical method was employed to analyze and summarize the data and to calculate percentages, frequency and mean.

### 3. RESULT AND DISCUSSION

In a little above half of the exploration sites (51.4%), *Osyris quadripartita* was not found. Only in few areas of the exploration sites (8.1%) *Osyris quadripartita* was relatively abundant. The relatively abundant exploration sites were:-Gelana, Shakiso and Lume districts. In some of the exploration site (Gelana) the size of the plant was small (at sapling stage) whereas in other exploration site (Shakiso district), the plant was found in most of the clumps of associated plants but the area that contained the clumps was very

small (around the farm land, communal land and near the fences) and somewhat medium in size. In the remaining exploration sites (40.5%) the status of *O. quadripartita* was rare and very rare. The result of similar study by [6] indicated that the regeneration status of *O. quadripartita* was somewhat fair in that particular study area, which is Menagesha Amba Mariam Forest in Central Highlands of Shewa, Ethiopia.

#### Population status of *Osyris quadripartita* in selected forest of Borena Zone

In Borena Zone from five districts (Teltele, Dillo, Miyo, Moyale and Dahas), seven forest and closure areas were purposively selected based on the information obtained from the key informants. In the majority these explored sites (71.4%), *O. quadripartita* doesn't exist. In the remaining explored sites (28.6%) *O. quadripartita* was present very rarely (Table 1).

**Table 1** *Osyris quadripartita* Exploration sites and their status in Borena Zone

No.	Exploration sites	Districts	Zone	Altitude (m.a.s.l)	Average no. of <i>Osyris</i> per plot (400 m <sup>2</sup> )	Present/ Absent	Status	Remark
1.	Bes biresa	Teltele	Borena	1397	No need of laying qadrat b/s it is very rarely available	Present	Very rare	State forest
2.	Halo	Teltele	Borena	1318	No need of laying qadrat b/s it is very rarely available	Present	very Rare	State forest
3.	Dillo areas (small forest around village)	Dillo	Borena	943	-----	Absent	Not found	-----
4.	Mite	Miyo	Borena	1292	-----	Absent	Not found	-----
5.	Moyale (small forest around village)	Moyale	Borena	1171	-----	Absent	Not found	-----
6.	Dahas Woreda (small forest around village)	Dahas	Borena	1348	-----	Absent	Not found	-----
7.	Wuchile	Dahas	Borena	1061	-----	Absent	Not found	----

#### Population status of *Osyris quadripartita* in selected forest of West and East Guji Zones

In East and West Guji Zones from seven districts (Abaya, Gelana, Melka soda, Goro-dala, Wadera, Adola and Shakiso ), sixteen forests and closures areas were purposively selected based on the information obtained from the key informants. In majority of exploration sites (57.9%), *O. quadripartita* was present. Of this 15.7% of the explored areas *O. quadripartita* was found relatively abundantly and 42.2% of the explored areas it was found rarely (21.1%) and very rarely (21.1%). A study by [7] in Tigray region, indicated that *O. quadripartita* was one of the dominant species in the study areas. On the remaining exploration sites (42.1%) *Osyris quadripartita* was not present (Table 2).

**Table 2** *Osyris quadripartita* Exploration sites and it status in West and East Guji Zones

No.	Exploration sites	Districts	Zone/ Region	Altitude (m.a.s.l)	Average no. of <i>Osyris</i> per plot(400 m <sup>2</sup> )	Present/ Absent	Status	Remark
	Debeka-debobesa	Abaya	West Guji, Oromia	1302	2	Present	Rare	In area closure and community forest
	Tore Badiya Forest	Gelana	West Guji, Oromia	1832	8	Present	Relatively abundance	Protected area & Very small in size (Sapling)
	Dawa becho	Melka soda	West Guji, Oromia	1321	-----	Absent	Not found	area closure and community forest
	Soda germama	Melka soda	West Guji, Oromia	1372	-----	Absent	Not found	area closure and community forest

	Udet to Negelle 1	-	East Guji	1065	----	Absent	Not found	----
	Udet to Negelle 2	-	East Guji	1476	-----	Absent	Not found	----
	Qilitu dalecha	Bob	East Guji	1542	-----	Present	Very Rare	Communal land
	Wato	Goro-dala	East Guji	1682 I	-----	Present	Very Rare	Community forest(uprooting cause its extinction)
	Bururi	Goro-dala	East Guji	1672	-----	Absent	Not found	-----
.	Wadera	Wadera	East Guji	1768	-----	Absent	Not found	-----
.	Zenbaba	Adola	East Guji	1975	----	Absent	Not found	Community forest
.	Boke	Adola	East Guji	1985	---	Present	Very rare	Community forest
.	Dibabate 1	Shakiso	East Guji	1700	Since it exists near fence and in the farm margins it was not favorable to lay quadrat	Present	Relatively abundance	Around the farm land, communal land and near the fences. Small in size and found in most of the clump but the total area that contain the clump is somewhat in small area
.	Dibabate 2	Shakiso	East Guji	1709	----	Present	very rare	Community forest
	Duda jarsa forest	Shakiso	East Guji	1710	----	Present	Rare	Community forest
.	Korba 1	Shakiso	East Guji	1741	----	Present	Rare	Community forest
.	Korba 2	Shakiso	East Guji	1730	----	Present	Rare	Community forest
.	Gunacho	Adola Redi	East Guji	1731	----	Present	Relatively abundance	In the farm land, communal land and near the fences but the total areas that contain the clump is small.
.	Anferara and Sokoro	Adola	East Guji	2197	----	Absent	Not found	Protected area

### Population status of *Osyris quadripartita* in selected forest of East Shewa Zone

In East Shewa Zone from seven districts (Liben Chqala, Dugida, Bora, Lume, Fentale, Boset and Adama), ten forests and closures areas were purposively selected based on the information obtained from the key informants. In a little above half of the exploration sites (54.5%), *O. quadripartita* were absent. On the other hand, in 45.5% of the exploration site *O. quadripartita* were present. Of this 9.1 % of the explored areas, *O. quadripartita* was found relatively abundantly and 27.3% of the explored areas it was found rarely and in 9.1% of the exploration sites *O. quadripartita* were found very rarely (Table 3).

**Table 3** *Osyris quadripartita* Exploration sites and it status in East Shewa Zone

No.	Explorations site	Districts	Zones	Altitude (m.a.s.l)	Average no. of <i>Osyris</i> per plot(400m <sup>2</sup>	Present / Absent	Status	Remark
1.	Zuqala forest	Liben Chqala	East Shewa	1844	Not found in the quadrat b/s it is very rare	Present	Very rare	Protected area
2.	Goro forest	Dugida	East Shewa	1816	----	Absent	Not found	Protected area
3.	--	Bora	East Shewa	1648	-----	Absent	Not found	-----



4.	Gererisa forest/Tede dildema Kebele	Lume	East Shewa	1848	-----	Present	Rare	Community forest, relatively larger in size but the total areas of the forest is very small
5.	Sike Ayu forest	Lume	East Shewa	1937	10	Present	Relatively abundance	Association forest,, relatively larger in size but the total areas of the forest is very small(only 14 ha)
6.	Fentale 1	Fentale	East Shewa	1207	-----	Absent	Not found	Community forest
7.	Tututi	Fentale	East Shewa	1402	-----	Absent	Not found	Area closure
8.	Buta dalecha	Boset	East Shewa	1654	-----	Present	Rare	Area closure
9.	Kechema Kenchero	Adama	East Shewa	1739	-----	Present	Rare	Community forest
10.	Dibibisa Kebele, Wacho lafa forest	Adama	East Shewa	1609	-----	Absent	Not found	Area closure
11.	Egizaherab forest	Adama	East Shewa	1603	-----	Absent	Not found	Community forest



**Figure 2** The three morphotypes of *Osyris quadripartita* observed during field work

### Local knowledge

In all the districts where *O. quadripartita* was found to grow, the species was recognized by a single local name "Watto". Tooth brush and women beautification were the two most important uses identified by informants. From the informants discussion it was also

known that the species can regenerate from root. If proved to be true, the fact that it can regenerate from left over root, it may have conservation implication.

### Taxonomic issues

Three types of morphotypes of the species were observed during the field work (Figure 2). Other species also may somewhat confusing for the species. These include; *Cadaba farinosa* and *Boscia mosambicensis* mainly in the Acacia-Comiphora type of ecosystems and *Osyridocarpus schimperanus* in the dry afromontane grass land kind of ecosystems. In addition to *Osyris quadripartita*, *Osyris compressa* was encountered in some parts of the study area.

### Habitat preference of *Osyris quadripartita*

In the present field work, it was possible to determine that *Osyris quadripartita* does not grow in plantation forest (*Cupressus* and *Eucalyptus* plantations). It was also observed that the species preferred degraded dry evergreen and Acacia-Comiphora forests, with clay textured soils. The study by Herrera (1988) indicated that *Osyris quadripartite* stony soil with clay texture.

### Threat to *Osyris quadripartita* populations

Over exploitation for its root have resulted in rapid decline in the *O. quadripartita* abundance in East Guji (Box 1). In Bora wereda of the Rift Valley, informants have mentioned charcoal making to be the one factor responsible for its reduction in abundance.

Box 1: *Osyris quadripartita* is now scarcely available even in the kebele named after it.

Watto kebele is found in the Gorodollo wereda of the East Guji zone, Oromiya. *Osyris quadripartita* was once a dominant plant in the area. Hence, the kebele was named “Watto” to mean *Osyris quadripartita* in afan Oromo. *Osyris quadripartita* in Watto kebele, like in other kebeles of the Guji zone, is traditionally used by women for beautification. The root is smoked to make the woman clean and smell good. The beautification use of *Osyris quadripartita* is highly valued by the Guji women. Likewise, there is a saying; “Wati busimelae, wattohimbusin” meaning; A Guji woman would rather prefer to lose a calf than to lose a single *Osyris quadripartita*. However, despite its availability in the past, *Osyris quadripartita* is now known to be very rarely available in the Watto kebele. This may be attributed to continuous over exploitation of the species for its root. Due to its current scares availability, nowadays, women cover *Osyris quadripartita* individuals with other twigs and leaves to hide it from being uprooted by other user. Therefore, *Osyris quadripartita* was found to be a conservation priority species for watto Kebele and other areas. This may be true for other similar kebeles of Guji and other zones as well.

### Associated Species with *Osyris quadripartita*

In different exploration sites, *O. quadripartita* was found associated with varieties of plant species. It was mostly occurring with *Dodonaea angustifolia*, *Acokanthera schimperi* and *Rhus spp.* (Table 4).

**Table 4** Species occurring with *Osyris quadripartita*

No.	Scientific name	Family	Remark
	<i>Acacia mellifera</i>	Fabaceae	
	<i>Acacia Senegal</i>	Fabaceae	
	<i>Acokanthera schimperi</i>	Apocynaceae	
	<i>Albizia spp,</i>	Fabaceae	
	<i>Aloe spp.</i>	Aloaceae	
	<i>Asparagus officinalis</i>	Asparagaceae	

	<i>Berchemia discolor</i>	Rhamnaceae	
	<i>Boscia</i> spp.	Capparidaceae	
	<i>Brucea antidysenterica</i>	Simaroubaceae	
	<i>Cadaba farinosa</i>	Capparidaceae	
	<i>Calpurnia aurea</i>	Fabaceae	
	<i>Capparis tomentosa</i>	Capparidaceae	
	<i>Carissa spinarum</i>	Apocynaceae	
	<i>Clutia abyssinica</i>	Euphorbiaceae	
	<i>Clematis hirsute</i>	Ranunculaceae	
	<i>Combretum molle</i>	Combretaceae	
	<i>Commiphora africana</i>	Burseraceae	
	<i>Cordia</i> spp.	Boraginaceae	
	<i>Croton macrostachyus</i>	Euphorbiaceae	
	<i>Dichrostachys cinrea</i>	Fabaceae	
	<i>Dodonaea angustifolia</i>	Sapindaceae	
	<i>Dombeya torrid</i>	Sterculiaceae	
	<i>Ficus</i> spp.	Moraceae	
	<i>Euclea racemosa</i> .	Ebenaceae	
	<i>Grewia bicolor</i>	Tiliaceae	
	<i>Harrisonia abyssinica</i> .	Simaroubaceae	
	<i>Juniperus procera</i> .	Cupressaceae	
	<i>Jasminum abysinica</i>	Oleaceae	
	<i>Maytenus arbutifolia</i>	Celastraceae	
	<i>Myrsine Africana</i>	Myrsinaceae	
	<i>Olea europaea</i>	Oleaceae	
	<i>Ozoroa</i> spp.	Anacardiaceae	
	<i>Podocarpus falcatus</i>	Podocarpaceae	
	<i>Polyscias fulva</i>	Araliaceae	
	<i>Rhus natalensis</i>	Anacardiaceae	
	<i>Senna occidentalis</i>	Fabaceae	
	<i>Solanum marginatum</i>	Solanaceae	
	<i>Syzygium guineense</i>	Myrtaceae	
	<i>Vernonia schimperi</i>	Asteraceae	
	<i>Ximenia american</i>	Olacaceae	
	<i>Ziziphus abyssinica</i>	Rhamnaceae	
	<i>Pappea capensis</i>	Sapindaceae	
	<i>Zanthoxylum chalybeum</i>	Rutaceae	

#### 4. CONCLUSION AND RECOMMENDATION

The results of this study indicated that in 51.4% of the explored sites *Osyris quadripartita* was not found. On the other hand in 40.5% of the exploration sites *Osyris quadripartita* was found rarely and very rarely. Therefore, in 91.9% of the exploration sites, *Osyris quadripartita* was found to be a conservation priority species. Contrary to this, only in few areas of the exploration sites (8.1%), *O. quadripartita* was relatively abundant.

Moreover, according to direct observation and informants' reports, the numbers of the plant have been greatly reduced due to overexploitation of its roots and stems for aesthetic purpose (natural perfume) and charcoal production. Furthermore, the plant's poor natural regenerative potential from seeds and root suckers, and its being dioecious threatens the survival of the plant, which leads to the extinction of the species. Consequently, the cultivation of the plant should be encouraged.



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## Abbreviations

PRA: - Participatory Rural Appraisal, CITES: Convention on International Trade in Endangered Species of Wild Fauna and Flora

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